Predicting deformation and stress as a function of additive manufacturing process parameters for Europa drill

Completed Technology Project (2017 - 2018)

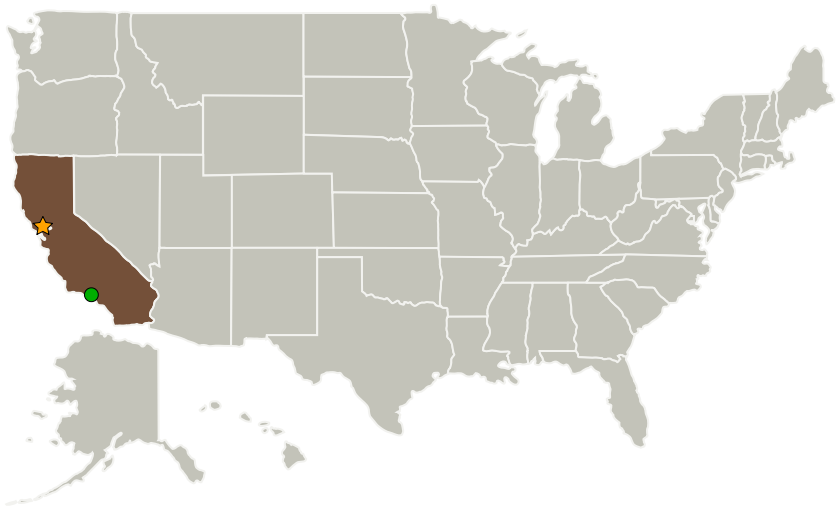
Project Introduction

We will combine part-level FEM model of residual stresses with phase-field transformation model to predict deformation and cracking due to thermal stresses from the AM building process. Next steps include fully-coupled, part-level thermo-mechanical simulation of the additive manufacturing process for assessing feasibility of employing an additive part on mission, and development of journal article and infusion into Glassgen's computational materials program, NESC and OSMA NDWG, STMD Rapid Analysis and Manufacturing Propulsion Technology (RAMPT), AMSII.

Anticipated Benefits

To use additive manufacturing for a Europa drill bit we need to be able to perform WHOLE part simulations tied across scales: microstructure and macro that predict deformation and cracking. Current state-of-the-art is simulation of only partial parts. Separate models are used at different scales (microstructure, melt-pool, larger thermal) without integration. We will scale & automate layer-by-layer whole part simulation, add advanced physics of evaporation, and overlay microstructural metal phase modeling.

Primary U.S. Work Locations and Key Partners



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Center Innovation Fund: ARC CIF

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Organizations Performing Work	Role	Type	Location
Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VQ

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Center Innovation Fund: ARC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

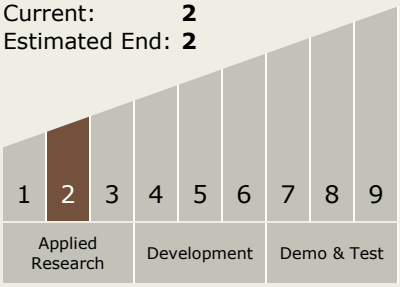
Harry Partridge

Principal Investigator:

Kevin B Wheeler

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **2**



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Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.2 Computational Materials

Target Destination

Others Inside the Solar System